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the new first row, a's in diagonal, and b third in second row. The scheme is then necessarily (I). If b is first in the second row, the scheme is either (II) or (III).

$$\text{(I)}\ \begin{array}{cccc} a & b & c & d \\ d & a & b & c \\ c & d & a & b \\ b & c & d & a \end{array} \qquad \text{(II)}\ \begin{array}{cccc} a & b & c & d \\ b & a & d & c \\ c & d & a & b \\ d & c & b & a \end{array} \qquad \text{(III)}\ \begin{array}{cccc} a & b & c & d \\ b & a & d & c \\ d & c & a & b \\ c & d & b & a \end{array}$$

If in (III) we interchange the second and third columns, and also rows, and permute b, c, we get (I).

We attach the subscripts to the letters of the first row in the order 1, 2, 3, 4. The diagonal terms must be $a_1a_4a_2a_3$ or $a_1a_3a_4a_2$. For (I), b in the second row must be b_1; in the former case, d in the fourth row must be d_4 contrary to d of the first row; in the latter case, d in the fourth row must be d_2, contrary to a of the fourth row. Hence (I) is excluded. For (II) the two schemes are evidently

$$(A)\ \begin{array}{cccc} a_1 & b_2 & c_3 & d_4 \\ b_3 & a_4 & d_1 & c_2 \\ c_4 & d_3 & a_2 & b_1 \\ d_2 & c_1 & b_4 & a_3 \end{array} \qquad (B)\ \begin{array}{cccc} a_1 & b_2 & c_3 & d_4 \\ b_4 & a_3 & d_2 & c_1 \\ c_2 & d_1 & a_4 & b_3 \\ d_3 & c_4 & b_1 & a_2 \end{array}$$

If we view the square (A) from the side, instead of the top, we get (B). If we reflect (A) on the main diagonal and then permute 2, 4, 3 cyclically, we obtain (B). But by no change of notation of letters or subscripts is (A) converted into (B). Note that the arrangements of the letters (as well as the subscripts) in (A) or (B) define the non-cyclic group of order 4.

These results for $n=4$ and n odd suggest that for $n=6$ the arrangements of the letters and subscripts might be derivable from those in the first row by means of the substitutions of the same regular group on six letters. But this is readily verified to be impossible. Hence if there is a solution for $n=6$, it is not a group solution of the type mentioned.

PROBLEMS FOR SOLUTION.

ALGEBRA.

228. Proposed by G. W. GREENWOOD, M. A. (Oxon), Professor of Mathematics, McKendree College, Lebanon, Ill.

Sum the infinite series

$$\frac{1}{11.13}+\frac{1}{23.25}+\frac{1}{35.37}+\frac{1}{47.49}+\frac{1}{59.61}+\cdots\cdots \qquad \text{[Oxford, 1895].}$$

229. **Proposed by B. F. YANNEY, Mount Union College, Alliance, O.**

If $a_1^n+a_2^n+a_3^n+\dots\dots+a_r^n=A^n$, $a_1^m+a_2^m+a_3^m+\dots\dots+a_r^m>$ or $<A^m$, according as $m<$ or $>n$; provided all the letters stand for positive real numbers.

230. **Proposed by G. W. GREENWOOD, M. A. (Oxon), Lebanon, Ill.**

Find the value of the determinant of n rows,

$$\begin{vmatrix} 5 & 2 & 0 & 0 & 0 & \dots\dots \\ 2 & 5 & 2 & 0 & 0 & \dots\dots \\ 0 & 2 & 5 & 2 & 0 & \dots\dots \\ 0 & 0 & 2 & 5 & 2 & \dots\dots \\ 0 & 0 & 0 & 2 & 5 & \dots\dots \\ \dots & \dots & \dots & \dots & \dots & \dots\dots \end{vmatrix}$$

[Oxford, 1900.]

231. **Proposed by O. L. CALLECOT, Omaha, Neb.**

Sum to infinity: $\dfrac{1}{2.3.4}+\dfrac{1}{5.6.7}+\dfrac{1}{8.9.10}+\dots\dots$

232. **Proposed by F. P. MATZ, Sc. D., Ph. D., Reading, Pa.**

If one person out of 50 die annually and one person out of 30 is born annually, how long at this rate would be required for the population to treble itself?

233. **Proposed by J. J. KEYES. Fogg High School, Nashville. Tenn.**

At what time between 10 and 11 o'clock is the second hand of a clock one minute space nearer to the hour hand than it is to the minute hand?

GEOMETRY.

254. **Proposed by W. J. GREENSTREET, M. A., Editor of the Mathematical Gazette. Stroud. England.**

Find the cartesian equation to a line that is both tangent and normal to the cardioid.

255. **Proposed by J. SCHEFFER. A. M., Hagerstown, Md.**

Find the envelope of the straight line that connects the extremities of two conjugate diameters of an ellipse.

256. **Proposed by F. P. MATZ, Ph. D., Sc. D., Reading, Pa.**

The bisectors of the four angles of any quadrilateral intersect in four points, all of which lie on the circumference of the same circle.

CALCULUS.

194. **Proposed by G. W. GREENWOOD, M. A. (Oxon), Lebanon, Ill.**

Show that the volume of the solid generated by the re
ment of a circle, less than a semi-circle, about the diameter par
is equal to that of a sphere having a diameter equal to the chord; and hence that the volume is independent of the magnitude of the original circle, the length of the chord being known.